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BOOKLET DEVELOPMENT BASED ON RESEARCH IDENTIFICATION OF FIDDLER CRAB (*Uca* spp.) DIVERSITY IN MANGROVE ECOSYSTEM

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ABSTRACT

The purpose of this development study is to develop research-based booklet for the identification of fiddler crab (Uca spp.) diversity. Some people do not yet know the ecological benefits of fiddler crabs. This is apparent when some people take fiddler crabs to serve as decorative crabs. The product specifications expected in the development of this medium are booklets. Therefore, it takes a companion learning media that can lead the local community to implement self-learning in the form of booklet because their interest of reading is very less, especially when reading a book that is colorless and has a lot of words. Booklet that is packed with interesting and accompanied by pictures is an alternative solution. The development method used in the research is Exploration, Explanation, and Evaluate (3E) model. The research was conducted by developing the research result into a booklet based on the diversity of fiddler crabs in mangrove ecosystem. The booklet validation consists of two lecturers from the Department of Biology Education at the University of Muhammadiyah Malang which is a material expert and learning media expert. The result of this research is booklet very valid with the percentage of material expert validity 81.25% and learning media expert 95.13%.

Keywords: *booklet, fiddler crab, mangrove ecosystem*

INTRODUCTION

Mangrove ecosystem is found along the coastline in the tropics region and support various ecosystem services, including fishery production and nutrient cycles (Cunha-Lignon et al., 2011; Donato et al., 2011; Tolangara, 2014). Mangrove characterized by muddy, slightly, and sandy area that influenced by the tide (Barros & Albernaz, 2014; Costa & Soares-Gomes, 2009; Irma & Sofyatuddin, 2012; Tolangara, 2014; Zakaria & Rajpar, 2015). The existence of this mangrove forest is to help prevent abrasion.

Mangrove plays an important role in the life cycle of various aquatic organisms such as crustaceans (Barros & Albernaz, 2014; Chatterjee, Mazumdar, & Chakraborty, 2014; Costa & Soares-Gomes, 2009; Hamidah, Fratiwi, & Siburian, 2014; Irma & Sofyatuddin, 2012; Koch, Wolff, & Diele, 2005; Lee et al., 2014; Penha-Lopes et al., 2009; Priyadarshani, Jayamanne, & Hirimuthugoda, 2008; Rufino de Oliveira Silva, Bezerra Ribeiro, Ernesto, Bezerra, & Bezerra, 2016; Shih, 2012; Zakaria & Rajpar, 2015; Zeil & Layne, 2002). Coastal mangrove ecosystem in Ketapang urban village of Probolinggo is one example of biodiversity source which has high crustacean diversity. Moreover, the mangrove ecosystem in the area is related to the activities of surrounding communities. These activities include socio-economic activities that have a direct link and relationship with the mangrove ecosystem (Chakraborty, 2013; Ghosh, Schmidt, Fickert, & Nüsser, 2015; Tolangara, 2014). However, the lack of community knowledge about mangrove species leads to low insight into the diversity of crustaceans, one of which is the fiddler crab.

Fiddler crab is a kind of crab that has habitat around mangrove forest and sandy beach (Cummings, Jord, Cronin, & Oliveira, 2008; Zakaria & Rajpar, 2015; Zeil & Layne, 2002). Some types of fiddler crabs are found in abundant quantities in mangrove habitats (Siburian, Hamidah, & Fratiwi, 2014). The mangrove ecosystem is consistently degraded

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and lost at an alarming rate due to human intervention, such as deforestation, coastal development, oil mining, salt production, excessive logging and domestic waste disposal (Tolangara & Sundari, 2013; Zakaria & Rajpar, 2015). Based on observations made during the research on the coast of Ketapang urban village, it appears that some people do not yet know the ecological benefits. This can be seen from the public's tendency to take fiddler crabs as decorative crabs. Based on the results of interviews with the head of community groups that the public know about fiddler crabs is still less so that many people are indifferent to the existence of fiddler crabs in the ecosystem. Mairo, Rahayuningsih, and Purwara (2015) states that the level of knowledge will affect attitudes. Good knowledge leads to a better awareness. Therefore, it takes a companion media that can direct the community to apply self-study in the form of a booklet.

On the other hand, the public or local community interest is very lacking, so it takes the learning media as an alternative that packs the information in an interesting and equipped image. The existence of a booklet as a learning media is one step that can be done to increase people's literacy on the existence of fiddler crab in the ecosystem. The improvement of local community literacy is expected to change their awareness on environmental management (Amin, 2010).

METHOD

The development model used is exploration, explanation, and evaluation (3E) model. The model is an adaptation of the engagement, exploration, explanation, elaboration, and evaluation or 5E learning cycle development model (Fatmawati, 2016; Sulastri, Mariani, & Mashuri, 2015). This research is done by developing research result into booklet based on diversity of mangrove ecosystem fauna. The validation subject for booklet development consists of a material expert and a media expert. The data were collected by questionnaire method. Data analysis techniques use data collection instruments and then performed in accordance with development research procedures (Yulistiana, 2010). Data consists of quantitative data and qualitative data. Quantitative data is converted into percentage form and then interpreted with qualitative sentences. Qualitative data were analyzed descriptively. Qualitative data obtained from the criticism and suggestions provided by the validator, while the quantitative data obtained from the questionnaire by the validator.

RESULTS AND DISCUSSION

Exploration

The results of research on the diversity of fiddler crabs in mangrove ecosystem in Ketapang using quadratic transect method is shown in Table 1 and Figure 1 (the example of the species found).

Table 1. Fiddler crab (*Uca* spp.) found in Ketapang urban village, Probolinggo, Indonesia

No.	Genus	Subgenus	Species
1.	Uca	Celuca	*Uca triangularis*
2.		Celuca	*Uca lactea*
3.		Celuca	*Uca jocelynae*
4.		Celuca	*Uca perplexa*
5.		Deltuca	*Uca coarctata*
6.		Deltuca	*Uca rosea*
7.		Deltuca	*Uca forcipata*
8.		Deltuca	*Uca dussumieri*
9.		Deltuca	*Uca spinata*
10.		Thalassuca	*Uca vocans*
11.		Thalassuca	*Uca tetragonon*
12.		Austaluca	*Uca bellator*

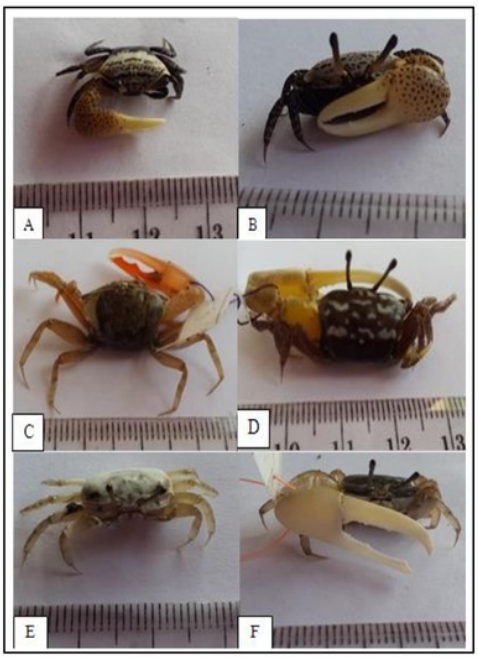

Figure 1. *Uca* spp.: (A) *Uca triangularis* (male-dorsal view), (B) *Uca triangularis* (male-frontal view), (C) *Uca jocelynae* (male-

dorsal view), (D), (E) *Uca lactea* (female-dorsal view), and (F) *Uca lactea* betina (male-frontal view).

Based on needs analysis shows that many local communities do not know that fiddler crabs have a very important ecological role in the mangrove ecosystem. This is due to the low level of community education around, as well as the lack of assistance from related agencies in order to campaign the ecological balance, especially the existence of fiddler crabs. The impact is 1) many people throw garbage into the mangrove forest, 2) land a boat around the mangroves, and 3) look for crabs and sea worms. Due to various human activities, mangrove ecosystem is clearly damaged and lost its function and impact on declining production of biota, especially fiddler crabs (Chatterjee et al., 2014; Ghosh et al., 2015; Hendy, Esler, Michie, & Taylor, 2014; Tolangara, 2014).

The result of the questionnaire of needs analysis is qualitatively captured to obtain the required status and solution. The results indicate that it is necessary to develop information materials that can facilitate the community to implement the learning process independently, such as the research-based booklet.

Explanation

The booklet is composed of introduction, content, and cover. The introductory section consists of; a) cover page, b) introduction, c) table of contents, and d) background. The booklet content consists of the types of fiddler crabs and morphological explanations and the role of fiddler crabs in the mangrove ecosystem. The closing section consists of bibliography and author biography. This booklet displays "do you know?" Features that provide unique features of fiddler crabs to facilitate community understanding. The booklets are arranged using a 12-size Corbel font and a clear image layout. this is to facilitate the readability aspect. In addition to designing the parts of the booklet, at this stage also done the preparation of instruments and materials media validation.

Stages in making booklet cover through several revisions by experts. Here is a cover booklet image that has been developed in Figure 2. The contents contain the types of fiddler crabs with morphology explanations and the role of fiddler crabs in the mangrove ecosystem. The types of fiddler crabs presented in the booklet plus the morphological descriptions of the fiddler crab are packed with an easy-to-understand language. Additional features "*did you know*?" On the content, the section contains the unique facts of the fiddler crab. The material presented in the booklet is structured in such a way that it can build community knowledge. Display the contents before being validated by the media expert that is presented in Figure 3.

Figure 2. Comparison of cover view: before revision (left) and after revision (right)

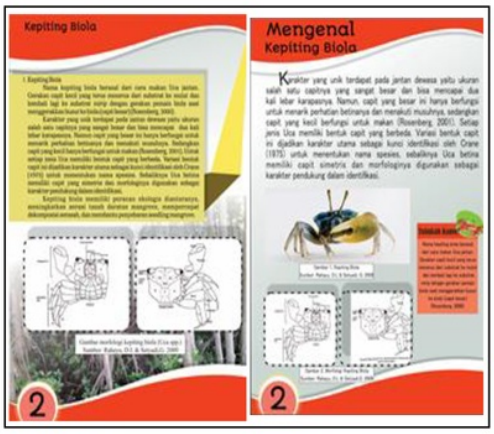

Figure 3. Comparison of content view: before revision (left) and after revision (right)

The validation stage is done by material experts and media experts using questionnaires. Expert validation aims to maintain the quality of the content as well as the readability of the booklet material (Miharja, Syamsuri, & Saptasari, 2015). The following is the result of the booklet validation described in Table 2.

Table 2. Validation results

No.	Validator	Result	Criteria
1.	Material experts	81.25%	Very valid
2.	Media experts	95.13%	Very valid

Based on these results can be seen that the validity of the booklet is very valid with some revisions such as changes in the cover appearance, anatomical names that discussed the English changed to the scientific language, and the selection of booklet design for the discussion section. The next stage is to make revisions according to the suggestion of the validator. Validation results from material and media experts indicate that the booklet can be understood, so it can be one of the alternative media information that can be used in the learning process for the community.

Development of this booklet is focused on the contents of the booklet is a description of the material and supporting images that are the result of identification that has been done before. This stage is very important because with the development of teaching materials based on contemporary research will provide the strengthening of education development based on the development of contemporary biological knowledge (Amin, 2010).

Evaluate

The results of booklet validation by material experts and media experts show the percentage of 81.25% and 95.13%, respectively. Based on the assessment qualification criteria, this booklet belongs to a very valid category so that it can be used by the public but with little revision in accordance with the corrections and suggestions from the validator.

Revisions were made based on improvements and suggestions from the material expert that fiddler crab image contained in the booklet cover. In the preliminary drawing before the revision, the fiddler crab displayed is so prominent that it does not show the whole morphology, so it is transformed into a smaller size with added mangrove background behind it, so that by looking at the front cover the reader understands that the fiddler crab lives in the mangrove ecosystem area. Revisions to the front cover have been aligned with suggestions from material expert validators. Revision cover booklet presented in Figure 4.

Figure 4. Comparison of cover view: before revision (left) and after revision (right)

Another improvement that is done is the anatomical name on the fiddler crab used on the booklet. Some anatomical names that use English have the potential to cause misconception replaced so that the concept is easier to be understood by the local community.

CONCLUSION

Based on the results of this development declared legitimate and feasible for use by the local community. The validation result of the booklet of the material and the learning media expert shows very validly, so the booklet can be used as an alternative research-based teaching material. However, there is a need for further studies to see how the effectiveness of the use of booklet by the local community.

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